Winchester
Laufwerk

10 MB

TANDON OEM OPERATING AND SERVICE MANUAL

MODEL NUMBERS TM602S, TM603S,AND TM603SE

5.25" RIGID DISK DRIVES

SEPTEMBER 20, 1982

PRELIMINARY

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SECTION I--GENERAL INFORMATION

1.1 SCOPE

This manual contains information useful in the installation and operation of Tandon Corporation's TM600 family of 5.25" rigid disk drives. This manual also contains interface requirements and descriptions of signals. TM600 refers to Model Numbers TM602S, TM603S, and TM603SE, as appropriate.

1.2 INTRODUCTION

The TM600 family of 5.25" rigid disk drives are low-cost, random access memories that use moving head, noncontact recording techniques. There are both two- and three-platter models, which use standard Winchester technology and 130 millimeter rigid media.

This drive consists of storage media that is contained within the drive in a fixed (nonoperator removable) configuration, read/write and control electronics, the drive mechanism, a read/write head, a precision split band positioning device, and an air filtration system.

Interface flexibility is provided by using an industry standard interface on the drive. The "S" version is compatible with larger capacity disk drives. Compatible is defined as using the same pin assignment where the signal and the function are common.

1.3 DISK DRIVE PERFORMANCE CHARACTERISTICS

The information contained in Table 1 pertains to all models of the Tandon TM600 family of disk drives.

1.4 DISK DRIVE MODEL SPECIFICATIONS

Table 2 contains a list of the drive models available and the number of platters each one has.

Table 1

Disk Drive Performance Characteristics

Model	TM602S	TM603S	TM603SE
Disks/Platters	2	3	3
Heads/Recording Surfaces	4	6	6
TPI	254 TPI		
Cylinders	153	153	230
RPM	3600 RPM ± 1 percent		
Recording Capacity, Unformatted:			
Per Drive	6.38 MBytes	9.57 MBytes	14.35 MBytes
Per Surface	1.59 MBytes	1.59 MBytes	2.39 MBytes
Per Track	10.40 KBytes		
Transfer Rate	5 Mbits per second		
Recording Density (BPI)	7690	7690	9625
Tracks	612	918	1380
Access Time			
Track-to-Track	3 milliseconds		
Average	153 ms, 99 ms ramped seek	153 ms, 99 ms ramped seek	210 ms, 137 ms ramped seek
Head Settling Time	15 milliseconds		
Average Latency	8.34 milliseconds		
Mechanical Dimensions			
Height	3.25 inch		
Width	5.75 inch		
Length	8.00 inch		
Error Rates			
Soft Read	$1X10^{10}$ bits		
Hard Read	$1X10^{12}$ bits		
Seek Errors	$1X10^{6}$ seeks		
Power			
+12V D. C. +/-	10% 1.5 amps tyical, 5 amps maximum for 10 seconds with no more than 5 millivolts PARD* (see Figure 1).		
+5V D. C. +/-	5% .8 amps typical with no more than 50 millivolts PARD*		
Environmental			
Ambient Temperature:	Operating:	16°C to 46°C (50°F to 115°F)	
	Nonoperating:	-35.4°C to 60°C (-40°F to 140°F)	
Relative Humidity:	8% to 80%		
Maximum Wet Bulb Temperature:	26°C without condensation		

*Periodic and Random Deviation.

Specifications Subject To Change Without Notice.

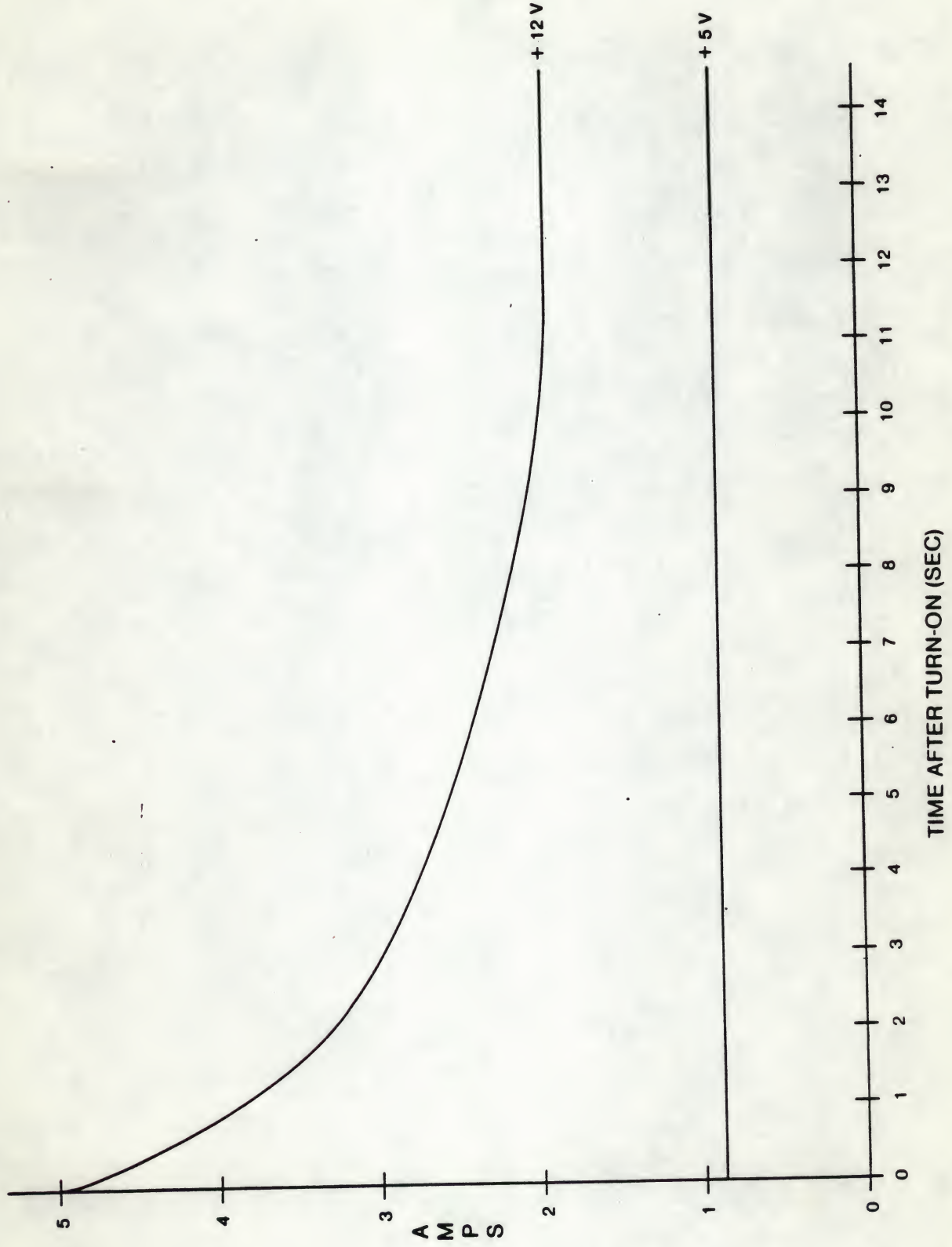


Figure 1
Typical Starting Currents At Nominal Voltage

Table 2

Disk Drive Model Specifications

Model Number	Number of Platters	Kind of Interface
TM602-S	2	Standard
TM603-SE	3	Standard/Extended Version
TM603-S	3	Standard

1.5 PHYSICAL DIMENSIONS

The major physical dimensions of the TM600 family of drives are contained in Figure 2. These dimensions are given in English and in metric units.

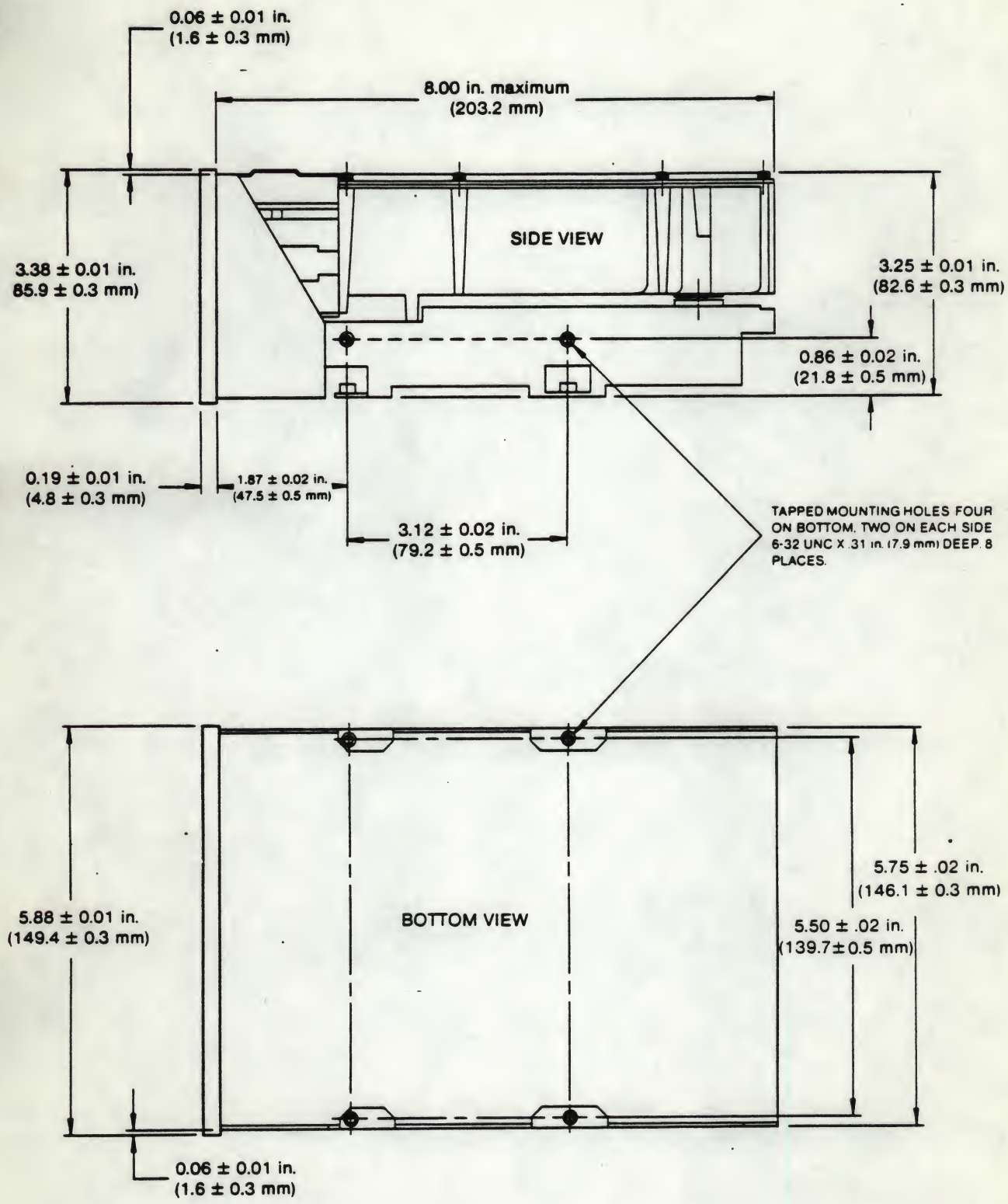


Figure 2

Disk Drive Physical Dimensions

SECTION II--INSPECTION, INSTALLATION, AND INTERFACES

2.1 INTRODUCTION

This section contains information pertinent to the inspection, installation, and interfaces of the Tandon TM6ØØ family of rigid disk drives.

The electrical interface between the drive and the host system is via four connectors. J1 provides control signals for the drive. J2 provides for the radial connection of read/write data signals. J3 provides for D. C. power. J4 provides for frame ground. Figure 3 contains the locations of the interface connectors.

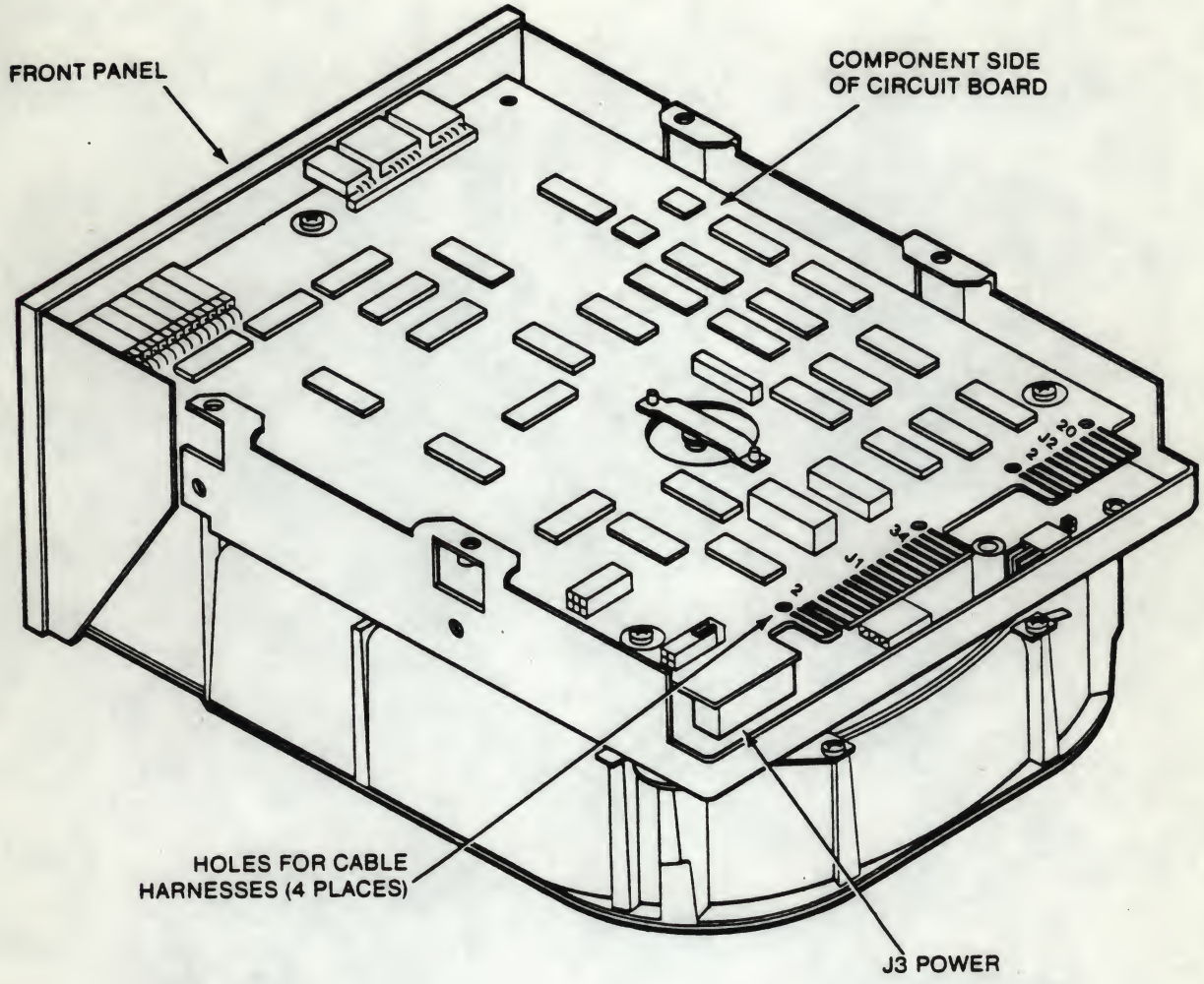
2.2 UNPACKING AND INSPECTION

The drive is shipped in a protective container which, when bulk packaged, minimizes the possibility of damage during shipment. The following procedure is the recommended method of uncrating the drive.

1. Place the shipping container on a flat work surface.
2. Remove the upper half of the inner container.
3. Remove the drive from the lower half of the inner container.
4. Check the model number and top assembly description against the packing slip.
5. Visually examine the contents of the shipping container for possible damage.
6. Notify the carrier immediately if any damage is found.
7. The inside chamber of the drive is a sealed compartment that must not be opened.

NOTE

REMOVAL OF THE COVER OF THE DRIVE INVALIDATES THE WARRANTY.



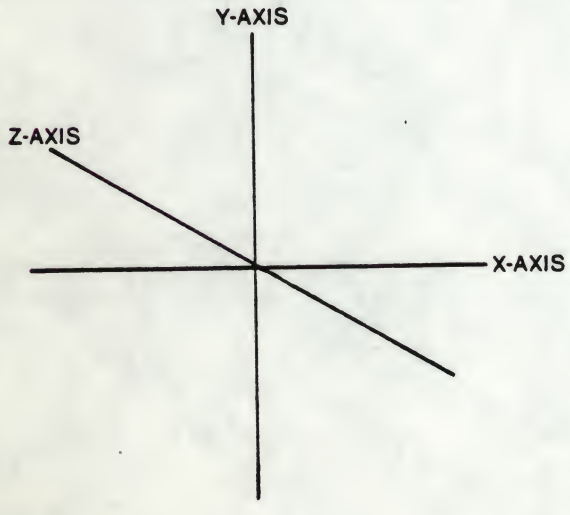


Figure 3

Locations of Interface Connectors

Before applying power to the disk drive, the following inspection procedure should be performed:

1. Check to ensure that the circuit boards are secure.
2. Check to ensure that the connectors are firmly seated.
3. Notify the carrier immediately if you find any damage.

2.3 MOUNTING CHARACTERISTICS

The mounting characteristics of the TM600 family of disk drives are contained in Figure 2. There are four 6-32, tapped mounting holes on the bottom of the disk drive, and two on each side of it.

2.4 POWER CABLING

The D.C. power connector, J3, is a four-pin AMP Mate-N-Lok device, P/N 350211-1, which is mounted on the solder side of the circuit board. The recommended mating connector, P3, is AMP P/N 1-480424-0, using AMP pins P/N 60617-4. J3 pins are labeled on the J3 connector. Figure 4 contains an illustration of the J3 connector.

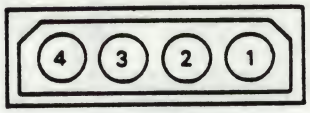


Figure 4

J3 Connector

The frame ground connector, J4 is the Faston AMP P/N 61761-2. The recommended mating connector is AMP P/N 62187-1.

2.5 STANDARD INTERFACE

The standard or "S" model interface is contained in Table 2-1. Connection to J1 is via a 34-pin circuit board edge connector. The dimensions of the J1 connector are found in Figure 5. The pins are numbered 1 through 34. The even numbered pins are located on the compoenent side of the circuit board. Pin 2 located on the end of the circuit board connentor closest to the D. C. power connector J3/P3, and it is labeled. A key slot is located between Pins 4 and 6.

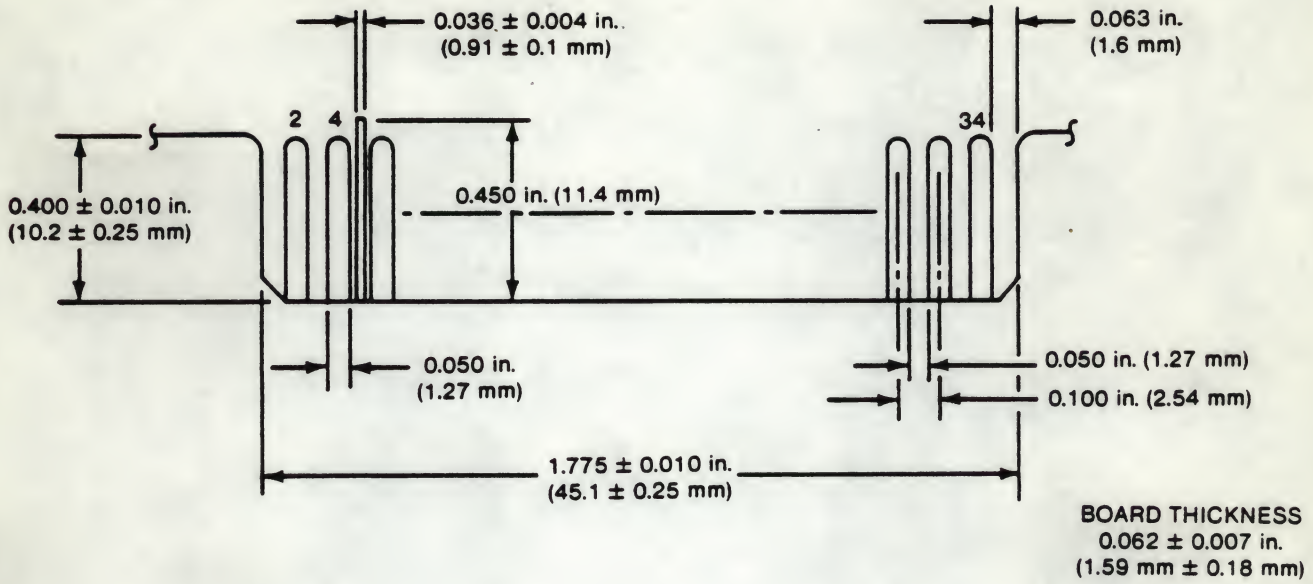


Figure 5
J1 Connector Dimensions

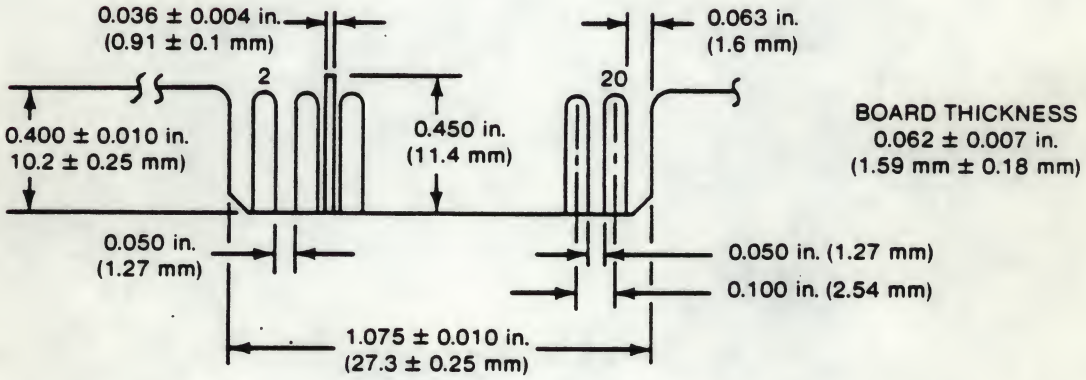


Figure 6

J2 Connector Dimensions

The recommended mating connector for P1 is a 3M ribbon connector, P/N 3463-0001, without ears.

Connection to J2 is via a 20-pin circuit board edge connector. The dimensions of the J2 connector are found in Figure 6. The pins are numbered 1 through 20. The even numbered pins are located on the component side of the circuit board. The recommended mating connector for P2 is a 3M ribbon connector, P/N 3461-0001, without ears. A key slot is located between Pins 4 and 6.

Table 3

Standard Interface

Connector	Interface Pin Number Signal	(Gnd)	Signal Type	I/O	Signal Name
P1	2	(1)	S	I	Reduce Write I
^	4	(3)	S	-	Head Select 2^2
|	6	(5)	S	I	Write Gate
|	8	(7)	S	O	Seek Complete
|	10	(9)	S	O	Track ØØØ
34-Pin	12	(11)	S	O	Fault
Ribbon	14	(13)	S	I	Head Select $2^Ø$
Daisy	16	(15)	-	-	Reserved (To J2-7)
Chain	18	(17)	S	I	Head Select 2^1
|	20	(19)	S	O	Index
|	22	(21)	S	O	Ready
|	24	(23)	S	I	Step
|	26	(25)	S	I	Drive Select Ø
|	28	(27)	S	I	Drive Select 1
|	30	(29)	S	I	Drive Select 2
|	32	(31)	S	I	Drive Select 3
v	34	(33)	S	I	Direction In
P1					
P2	1	(2)	S	O	Drive Selected
^	3	(4)	S	-	Reserved (+5 V)
|	5	(6)	S	I	Reset
|	7	(8)	-	-	Reserved (To J1-16)
20-Pin	9	(10)	-	-	Spare
Ribbon	11	(12)	-	-	Ground
Daisy	13		D	I	+ Write Data
Chain	14		D	I	- Write Data
or	15	(16)	-	-	Ground
Radial	17		D	O	+ Read Data
v	18		D	O	- Read Data
P2	19	(20)	-	-	Ground
P3	1			-	+12 V D. C. In
^	2			-	12 V Return
4-Pin Power	3			-	5 V Return
Radial	4			-	+5 V D. C. In
v					
P3					

Notes:

1. S - Single ended
2. D - Differential
3. I - Drive input
4. Ø - Drive output

SECTION III--THEORY OF OPERATION

3.1 INTRODUCTION

There are three kinds of interface signals:

1. Input Control Lines
2. Output Control Lines
3. Data Transfer Lines

Signals on the Input Control lines are standard TTL levels. They have the following electrical specifications:

True: Ø.Ø volt D. C. to Ø.4 volt D. C. @ I = 4Ø mA maximum

False: 2.5 volt D. C. to 5.25 volt D. C. @ I = Ø mA open

See Figure 7 for the recommended circuit.

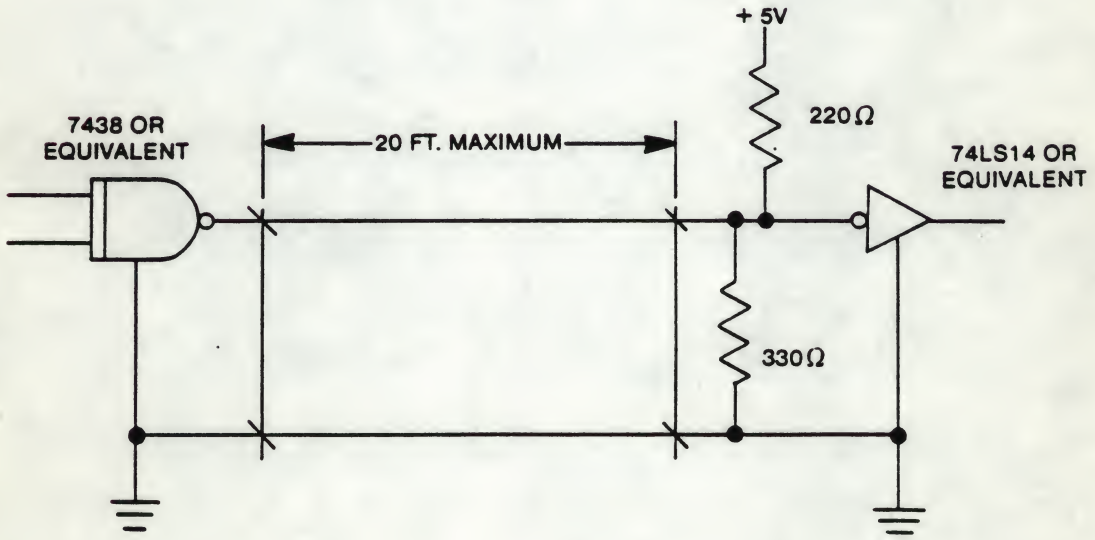


Figure 7

Control Signal Driver/Receiver Circuit Combination

3.2 INPUT CONTROL LINES

There are two kinds of Input Control lines, those that are multiplexed in a multiple drive system and those that do the multiplexing.

The Input Control lines that are multiplexed include:

1. Reduced Write Current
2. Write Gate
3. Head Select
4. Step Interface
5. Direction In

The Input Control lines that do the multiplexing are:

1. Drive Select Ø
2. Drive Select 1
3. Drive Select 2
4. Drive Select 3

3.2.1 Reduced Write Current

When this Input Control line is activated low (true) in conjunction with the write gate, a lower value of write current is selected for writing on the disk. When the signal is set high (false), the higher value write current is selected. When writing on Tracks Ø through 127, it is recommended that this line be set false. For Tracks 128 and greater, the Reduced Write Current line should be set true.

A 220/230 ohm resistor pack allows the line to be terminated.

3.2.2 Write Gate

The Write Gate signal enables data to be written on the disk when it is activated or when the logical zero (true) level is reached. The ready line must be valid before write gate is activated. If a disk drive fault occurs, further writing on the disk is prohibited. In addition, the Seek Complete line should go true before you begin to write any information on the disk.

The inactive or logical high (false) level on the Write Gate line enables the step pulses to step the head arm actuator.

3.2.3 Head Select

There are three Head Select lines. They are used to select each read/write head--Ø, 1, or 2--in a binary coded sequence.

Head Select signals are logic low (true) levels. They must be activated in conjunction with the Drive Select lines. The heads are numbered Ø through 5. Head Select Ø is the least significant line. Table 3-1 contains information about the Head Select line sequence, disk drive model number, and numbers that may be selected.

Table 3-1

Head Select

Head Select Line Sequence			Model Number	
			TM6Ø2	TM6Ø3
2^2	2^1	$2^Ø$	Head Number	Selected
1	1	1	Ø	Ø
1	1	Ø	1	1
1	Ø	1	2	2
1	Ø	Ø	3	3
Ø	1	1		4
Ø	1	Ø		5

Legend: 1 = Logical High (False)
Ø = Logical Low (True)

A 22Ø/33Ø ohm resistor pack allows the line to be terminated.

3.2.4 Step Interface

When the Step Interface line is activated in conjunction with the Direction In line, the read/write heads move in the direction defined by the Direction In line. The motion is initiated by a logical zero to a logical one transition or by the trailing edge of the step pulse. Any change in the Direction In line must be made one hundred nanoseconds before the leading edge of the step pulse. The quiescent state of this line should be held logically high (false).

The heads move at the rate of the incoming step pulses. Figure 8 contains the sequence and the requirements for step timing.

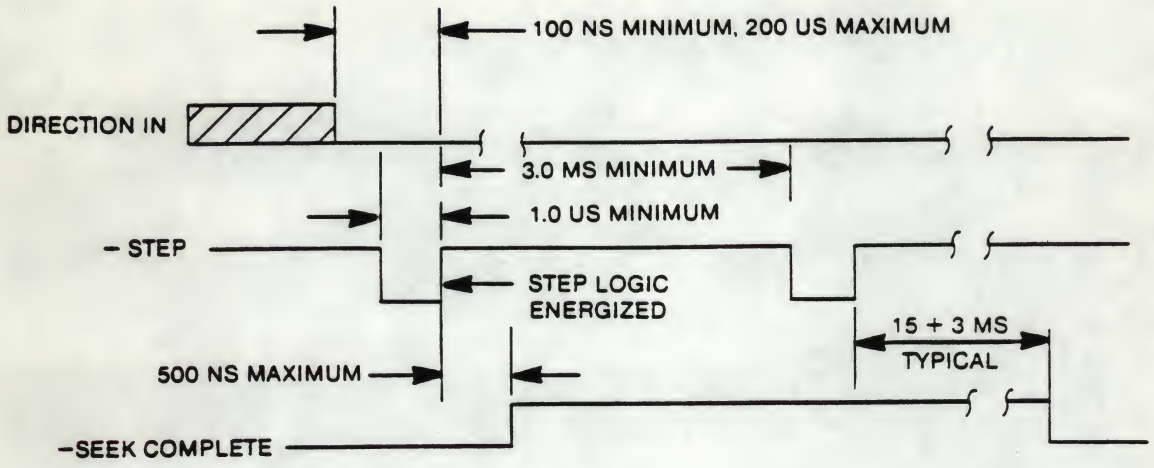


Figure 8

Step Mode Timing Diagram

3.2.5 Direction In

The Direction In line determines the motion of the read/write heads when a step pulse is issued. The motion is toward the center of the disk if the Direction In line is in the true (low) state when a step pulse occurs. The direction of the motion is away from the center of the disk if the Direction In line is in the false (high) state when a step pulse occurs.

A 220/330 ohm resistor pack allows the line to be terminated.

3.2.6 Drive Select

Drive Select lines 0 through 3 provide a means of selecting and deselecting a drive. These four lines select one of four drives that are daisy chained to the controller.

The drive address is determined by a select shunt on the Signal circuit board. Drive Select lines 0 through 3 provide a means of daisy changing a maximum of four drives to a controller.

When logically high (false), the output drivers are open circuits or logically high (false), and the drive receivers do not acknowledge signals presented to them. A Drive Select line must remain stable in the true (low) state until a Step or Read/Write command is executed.

Only one line can be true (low) at a time. An undefined operation might result if two or more units are assigned the same address or if two or more Drive Select lines are in the true (low) state simultaneously.

3.3 OUTPUT CONTROL LINES

The Output Control lines are enabled by their respective Drive Select line. They send status information to the controller, such as: drive selected, seek complete, Track000 fault, and line ready. In addition, the Index line is provided as an output to the controller for timing information.

The Output Control lines use an open collector gate that is capable of sinking a maximum of forty milliamperes in a logical low (true) level, with a maximum voltage of 0.4 volt measured at the driver. When the gate is off or logically high (false), the collector cutoff is a maximum of 250 u amps. See Figure 8 for the recommended circuit.

3.3.1 Drive Selected

When the Drive Selected lines coincide with the selected jumper on the shunt pack, the Select Status line goes logically low (true). This line informs the host system of the selection status of the drive.

NOTE

ONLY ONE DRIVE MAY BE SELECTED AT A TIME.

3.3.2 Seek Complete

The Seek Complete line indicates that the read/write heads have settled on the selected track at the end of a seek sequence. This status line is set logically zero (true) at the end of a normal seek. It is set logically high (false) in two cases:

1. A recalibration sequence is initiated by drive logic at power on because the heads are not over Track 000.

2. Five hundred nanoseconds, typical, after the leading edge of a step pulse or of a series of step pulses.

3.3.3 Track 000

The Track 000 line indicates to the host system that the read/write heads are positioned on Track 000. The Track 000 line goes logically low (true) only when the heads are positioned on Track 000. It remains low until the heads are moved away from Track 000, the outermost data track.

3.3.4 Fault

The Fault line indicates to the host system that a condition exists on the disk drive that is going to cause improper writing on the disk. When this line is logically low (true), Write Data is inhibited and further writing on the disk is pro-hibited until the condition is corrected. The condition under which the Fault line goes true is that D.C. voltages are grossly out of tolerance.

3.3.5 Line Ready

In conjunction with the Seek Complete line, the Line Ready line indicates to the host system that the disk drive can read, write or seek, and that all I/O signals are valid. The Line Ready line goes logically low (true) approximately 15 seconds after power on. The Line Ready line goes logically high (false) if the drive is not selected or if the speed of the motor is too slow. When this line is false, all writing and seeking is inhibited.

3.3.6 Index

An index pulse is provided once every revolution (16.67 ms nominal) to indicate the beginning of a track to the con-troller. The transition from logically high (false) to logically low (true) is the only valid transition. The leading edge of the pulse must be used to ensure accurate timing.

3.4 DATA TRANSFER LINES

The Data Transfer lines transfer information between the host system and the disk drive when the drive is selected. These lines are differential in nature. They may be multiplexed when using Drive Select.

The MFM Write Data pair of lines and the MFM Read Data pair of lines are provided for the transfer of data. Figure 9 contains a typical driver/receiver circuit combination used for data transfer signals.

3.4.1 MFM Write Data

The MFM Write Data lines are the differential pair that provide the data to be stored on the track. A flux reversal on the track to be written is caused when the plus (+) MFM

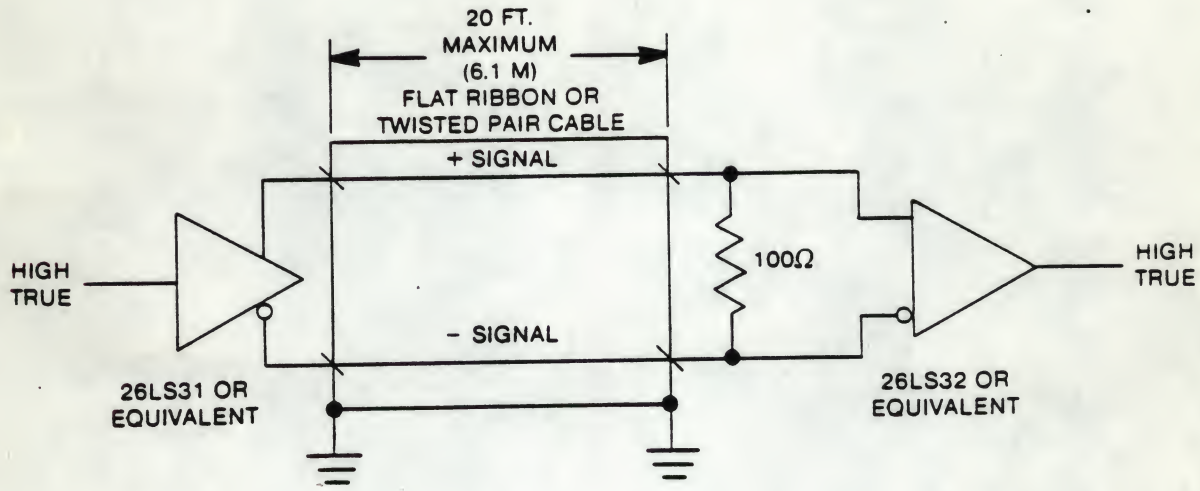


Figure 9

Data Line Driver/Receiver Circuit

Write Data line goes more positive than the minus (-) MFM Write Data line, provided that the Write Data line is logically low (true). When the disk drive is in a Read mode, the host system must ensure that the MFM write data signals are in the inactive state. The inactive state can be attained by making the plus MFM Write Data line more negative than the minus MFM Write Data line.

3.4.2 MFM Read Data

These lines are a differential pair that recover the data previously written on a track. A flux reversal on the track to be read is caused when the plus MFM Read Data line goes more positive than the minus MFM Read Data line. Subsequently, the differential pair signal is transmitted to the host system via the MFM Read Data lines.

APPENDIX A

CUSTOMER INFORMATION BULLETINS

CUSTOMER INFORMATION BULLETIN

TM600 RIGID DISK DRIVE

RAMPED SEEK MODE

Tandon uses a Customer Information Bulletin to inform our customers of changes in and improvements to our products. The following information is an option on the Tandon TM600 family of rigid disk drives that may be of interest in your application.

Our current drives are designed to operate at a minimum time between steps of three (3) milliseconds. Given eighteen (18) milliseconds for last step and settling time, this step rate results in an average seek time of 170 milliseconds for the 153 cylinder drive.

Customer requirements may necessitate a reduction in average seek time. By using the ramped seek mode and giving correct step pulse timing, the present drive's average access time can be improved.

A. In order to use a ramped seek, four major conditions must be met:

1. The drive must have a Control and Data circuit board, P/N 187045-001.

2. The Pins 8 and 9 programming shunt of the Control and Data circuit board must be closed (shorted).

3. The viscous damper must be mounted to the stepper motor.

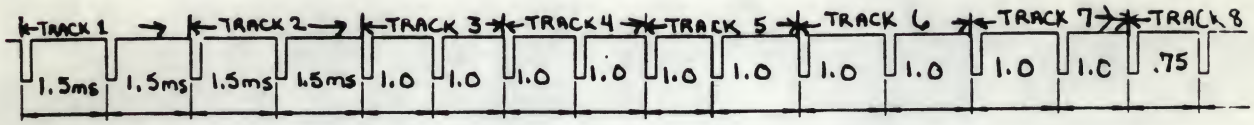
4. The controller must issue step pulses in accordance with the algorithm below. Note that two pulses per track are required in ramped seek.

B. The pulse timing for single-track to nine-track seek is:

Two pulses separated by 1.5 milliseconds for each track, i.e., a one-track seek is equal to two pulses, a nine-track seek is equal to fourteen pulses.

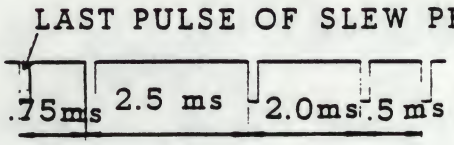
C. Pulse timing for an 10 track seek or greater.

1. Acceleration Phase:



2. Slew Phase: two pulses separated by .75 milliseconds for each track.

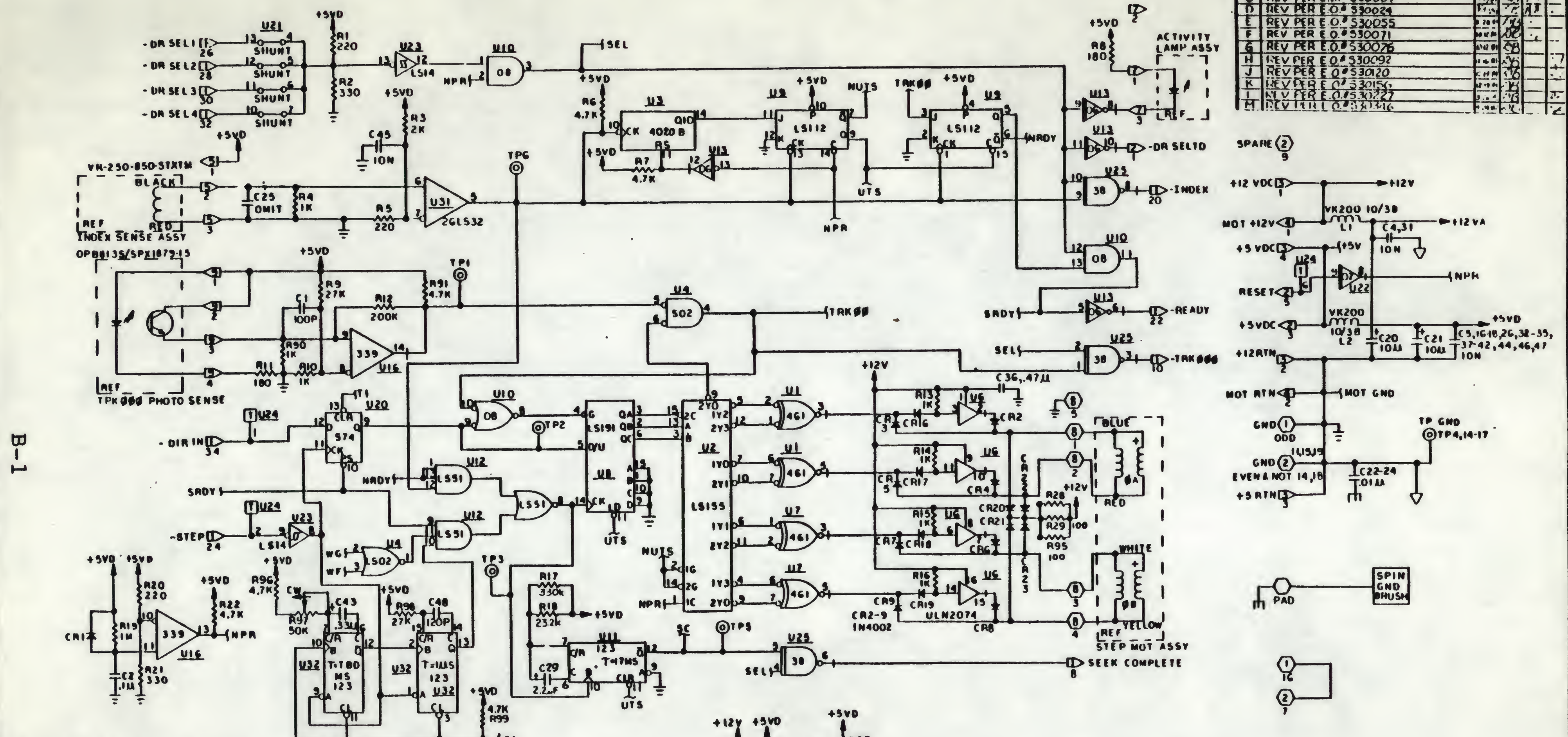
3. Deceleration Phase: last two tracks or seek.



If you have any questions or need additional information, please do not hesitate to contact me.

APPENDIX B

SCHEMATICS



9. UNVALUED COMPONENTS ARE OMITTED.

8. DENOTES PIN X OF RESISTOR TERM PAK: +5 220 330

7. DENOTES TEST POINT.

6. Y OR Y OR Y DENOTES CONNECTOR JX, PIN Y.

5. INDUCTORS ARE IN µH, 10%.

4. DIODES ARE IN4446 OR EQUIV.

3. CAPS ARE IN µF, NF, OR PF, 25V TOLERANCE IS 10% FOR VALUES ABOVE 1000P AND 5% OTHERWISE.

2. 1% RESISTORS ARE 1/8W, METAL FILM.

1. RESISTORS ARE IN OHMS, 1/4 W, 5%.

REVISIONS

REV	DESCRIPTION	DATE	DR	CHK	APP
A	REL TO MFG [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	REV PER E.O.# [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	REV PER E.O.# 530007	[illegible]	[illegible]	[illegible]	[illegible]
D	REV PER E.O.# 530024	[illegible]	[illegible]	[illegible]	[illegible]
E	REV PER E.O.# 530055	[illegible]	[illegible]	[illegible]	[illegible]
F	REV PER E.O.# 530071	[illegible]	[illegible]	[illegible]	[illegible]
G	REV PER E.O.# 530076	[illegible]	[illegible]	[illegible]	[illegible]
H	REV PER E.O.# 530092	[illegible]	[illegible]	[illegible]	[illegible]
J	REV PER E.O.# 530120	[illegible]	[illegible]	[illegible]	[illegible]
K	REV PER E.O.# 530156	[illegible]	[illegible]	[illegible]	[illegible]
L	REV PER E.O.# 530227	[illegible]	[illegible]	[illegible]	[illegible]
M	REV PER E.O.# [illegible]	[illegible]	[illegible]	[illegible]	[illegible]

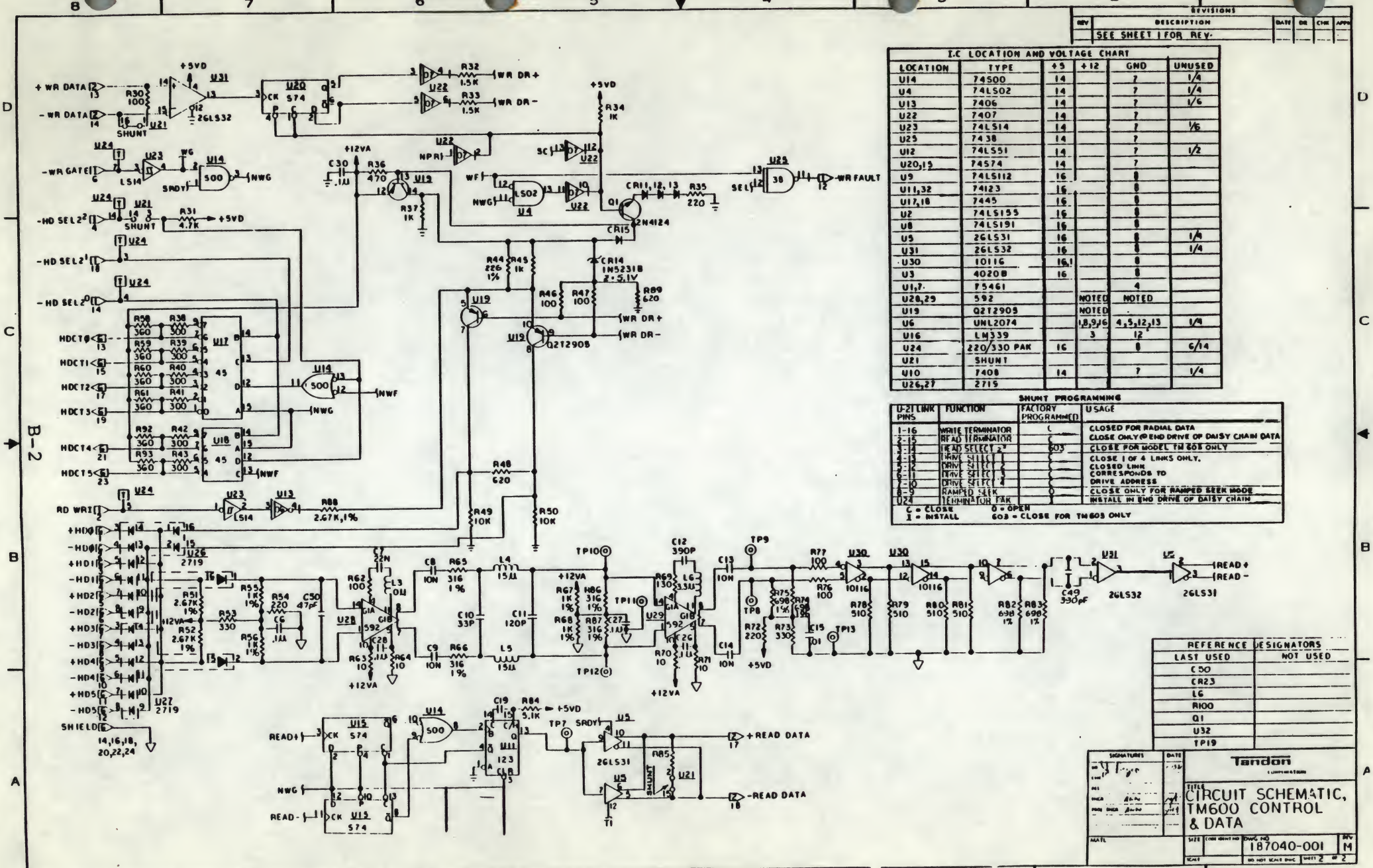
Tandon

TITLE: CIRCUIT SCHEMATIC TM600 CONTROL & DATA

DWG NO 187040-001 REV M

DO NOT SCALE DWG

B-1



REVISIONS					
REV	DESCRIPTION	DATE	DR	CHK	APP'D
	SEE SHEET 1 FOR REV.				

I.C LOCATION AND VOLTAGE CHART

LOCATION	TYPE	+5	+12	GND	UNUSED
U14	74S00	14		7	1/4
U4	74LS02	14		7	1/4
U13	7406	14		7	1/6
U22	7407	14		7	
U23	74LS14	14		7	1/6
U25	7438	14		7	
U12	74LS51	14		7	1/2
U20,15	74S74	14		7	
U9	74LS112	16		8	
U11,32	74123	16		8	
U17,18	7445	16		8	
U2	74LS155	16		8	
U8	74LS191	16		8	
U5	26LS31	16		8	1/4
U31	26LS32	16		8	1/4
U30	10116	16.1		8	
U3	4020B	16		8	
U1,7	75461			4	
U28,29	592		NOTED	NOTED	
U19	Q2T2905		NOTED		
U6	UNL2074		1,8,9,16	4,5,12,13	1/4
U16	LM339		3	12	
U24	220/330 PAK	16		8	6/14
U21	SHUNT				
U10	7408	14		7	1/4
U26,27	2719				

SHUNT PROGRAMMING

U-21 LINK PINS	FUNCTION	FACTORY PROGRAMMED	USAGE
1-16	WRITE TERMINATOR	C	CLOSED FOR RADIAL DATA
2-15	READ TERMINATOR	C	CLOSE ONLY @ END DRIVE OF DAISY CHAIN DATA
3-14	READ SELECT 2*	603	CLOSE FOR MODEL TM 603 ONLY
4-13	DRIVE SELECT 1	C	CLOSE 1 OF 4 LINKS ONLY.
5-12	DRIVE SELECT 2	O	CLOSED LINK
6-11	DRIVE SELECT 3	O	CORRESPONDS TO
7-10	DRIVE SELECT 4	O	DRIVE ADDRESS
8-9	RAMPED SEEK	O	CLOSE ONLY FOR RAMPED SEEK MODE
U24	TERMINATOR PAK	I	INSTALL IN END DRIVE OF DAISY CHAIN

C = CLOSE O = OPEN
I = INSTALL 603 = CLOSE FOR TM603 ONLY

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C50	
CR23	
L6	
R100	
Q1	
U32	
TP19	

SIGNATURES | DATE

Tandon

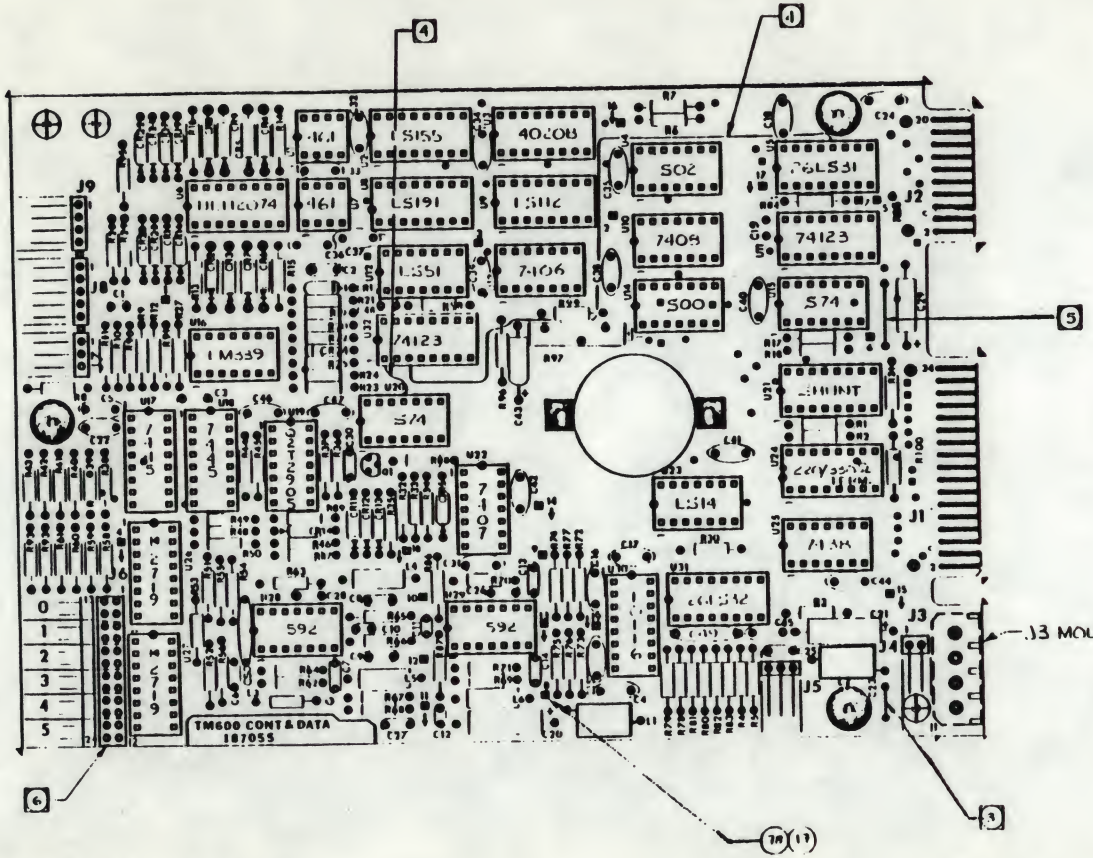
TITLE: CIRCUIT SCHEMATIC, TM600 CONTROL & DATA

SIZE | CODE IDENT NO | DWG NO: 187040-001 | REV: M

SCALE: DO NOT SCALE DWG | SHEET 2 OF 2

REVISIONS				
REV	DESCRIPTION	DATE	BY	CHK
B	REV PER E.O. 530007			
C	REV PER E.O. 530024			
D	REV PER E.O. 530025			
E	REV PER E.O. 530071			
F	REV PER E.O. 530075			
G	REV PER E.O. 530092			
J	REV PER E.O. 530120			
K	REV PER E.O. 530156			
L	REV PER E.O. 530157			
M	REV PER E.O. 530227			
N	REV PER E.O. 530250			
P	REV PER E.O. 530318			
R	REV PER E.O. 530329			
S	REV PER E.O. 530331			
T	REV PER E.O. 530346			

DESIGNATOR ASSEMBLY GUIDE		
LAST USED	NEXT USED (SHEET 1)	NEXT USED (SHEET 2)
C48	C19	C23-BUS
CR24	CR10	
J9		
L6		L3-05
Q1		
R100	R17,58	
TP19		
U32		

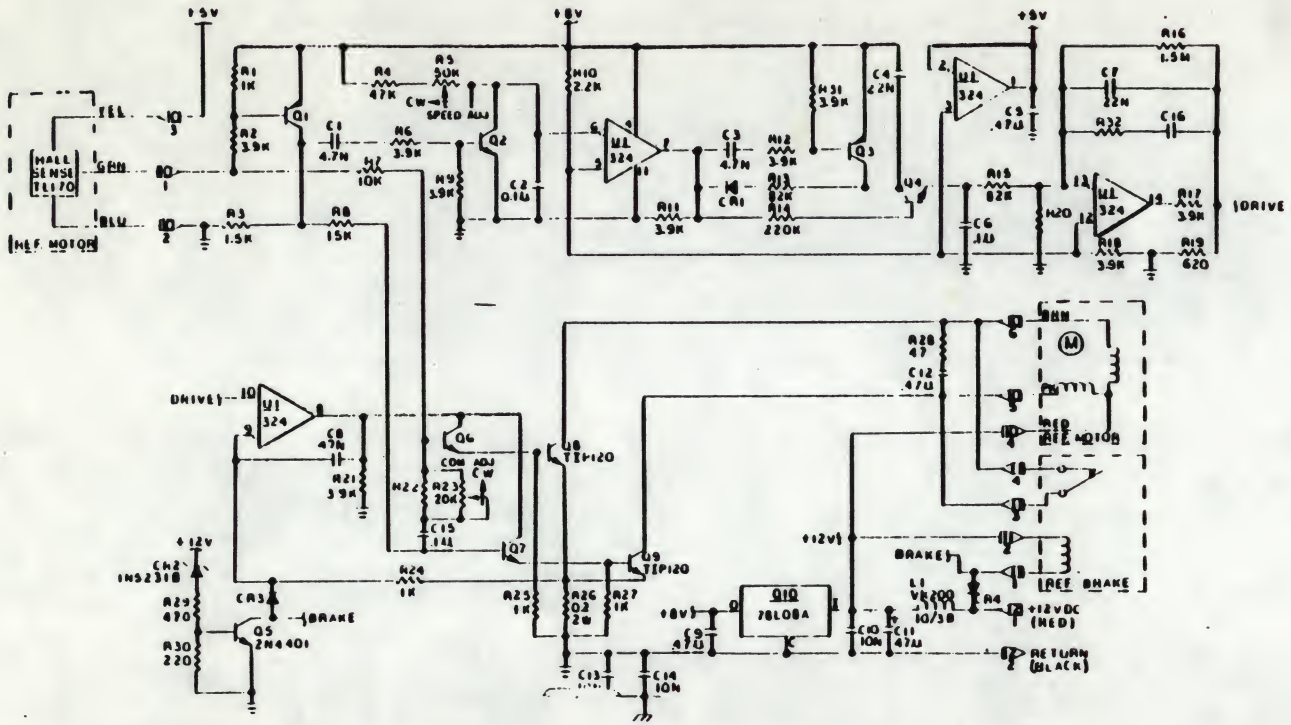


6. RAISE CONNECTOR J6 TO .060 INCHES ABOVE SURFACE PER E.O. 530318.
5. JUMPER PER E.O. 530156.
4. JUMPER PER E.O. 530024.
3. SOLDER #24 AWG UNINSULATED TIN COATED SOLID COPPER WIRE. MAY SUBSTITUTE 1/4W RESISTOR LEAD WIRE.
2. REF DOCUMENT: 187040-001 - CIRCUIT SCHEMATIC
   187042-001 - ARTWORK
1. SEE SHEET 1 AND 3 FOR PART LIST

Tandon

ASSEMBLY, TM600 CONTROL & DATA

187045-001 T



B-4

7. UNVALUED COMPONENTS ARE OMITTED.
6. X OR Y DENOTES CONNECTOR X, PIN Y.
5. PNP TRANSISTORS ARE 2N4125.
4. NPN TRANSISTORS ARE 2N4124.
3. DIODES ARE IN4446 OR EQUIV.
2. CAPACITORS ARE 25V, 10%, PF, NF, OR UF.
1. RESISTORS ARE IN OHMS, 1/4W, 5%.

REVISIONS					
REV	DESCRIPTION	DATE	BY	CHK	APP
B	REV PER ECO 11529				
C	REV PER ECO 11858				
D	REV PER ECO 12006				
E	REV PER ECO 12143				

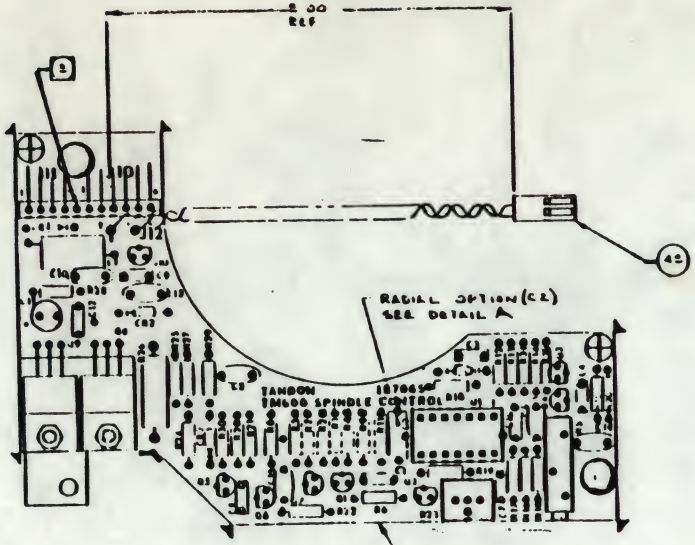
REFERENCE DESIGNATORS	
LAST USED	NOT USED
C16	
CR4	
J3	
L1	
Q10	
R32	
U4	

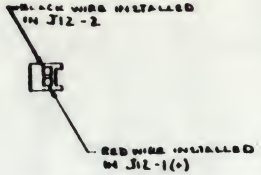
Tandon

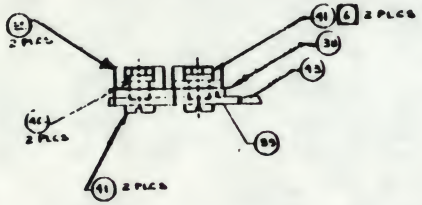
TITLE: CIRCUIT SCHEMATIC, TM600 SPINDLE CONTROL

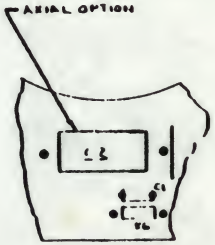
187060-001 E

REVISIONS					
REV	DESCRIPTION	DATE	BY	CHK	APP'D
B	REV PER ECO 530036				
C	REV PER ECO 530043				
D	REV PER ECO 530046				
E	REV PER ECO 530049				









DETAIL A

7. REF DOCUMENT : 187060 ON CIRCUIT SCHEMATIC
187062-001 - ARTWORK

6. TORQUE 4.5 INCH LBS NOMINAL

5. MAX LENGTH OF COMPONENT LEADS BELOW SOLDER SIDE BOARD AFTER ASSEMBLY & TRIMMING SHALL NOT EXCEED .08 INCH.

4. COMPONENT HEIGHT, EXCEPT C11, SHALL NOT EXCEED .45 INCH ABOVE BOARD. CAPACITOR C11, NOT TO EXCEED .55 INCH ABOVE BOARD.

3. CUT PIN TANGENT TO PIN CARRIAGE.

2. THIS ASSEMBLY SHALL BE MADE FROM P.C.B DETAIL 187060-001

1. ASSEMBLY PER STANDARD MANUFACTURING METHODS.

MATERIAL	DATE	Tandon
FINISH		TITLE SPINDLE CONTROL ASSY TM600
MFR		189003-001 REV E